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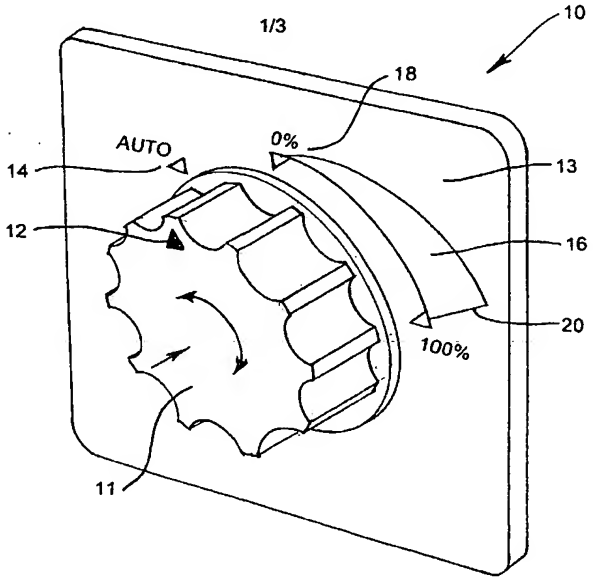

(57) Abstract: An automatic or manual system for operating electric brakes of a vehicle including an actuator (11) actuatable by the vehicle driver between at least first and second actuation phases separated by indication means that define a point of differentiation between the first and second actuation phases. The system operates the electric brakes in a first mode of brake operation when the brake actuator (11) is actuated in the first actuation phase and operates the electric brakes in a second mode of brake operation when the actuator is actuated to the second actuation phase. The second mode of operation applies brakes in a different manner to the first mode of operation. An electric parking brake system including automatic and manual mode of operation is also disclosed.

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SYSTEM OF OPERATION OF AN ELECTRIC BRAKE

The present invention relates to a system for the operation of an electric brake installed in an automotive vehicle. The invention has been developed principally for use in the operation of an electric parking brake, but it is envisaged and expected that the invention could be applied also to electric service brakes of an automotive vehicle, either as a separate system of operation, or as an overall system for the operations of both the service and parking brakes. It will be convenient however, to describe the invention only as it relates to the operation of the parking brakes of a vehicle, but it is to be appreciated that the invention is not limited to parking brake operation only.

Electric operation of parking brakes advantageously permits the parking brakes to be applied with significantly reduced effort compared to manual operation. Manual parking brakes typically are lever operated and it is necessary to apply a lifting force to the lever to apply the parking brakes. In contrast, in an electric operated parking brake, the application force is applied by an electric actuator, for example, an electric motor, so that the above manual effort is not required.

Electric brake application does however present a difference in brake application compared to manual actuation. To ensure drivers are not disadvantaged by the replacement of manual parking brakes with electric parking brakes, electric application preferably must provide the same level of control that is available for manual application, but, preferably is operable to provide enhanced control, to simplify the braking procedure and to improve vehicle safety.

According to a first aspect of the present invention there is provided a system for a vehicle which employs electric brakes, said system being operable for operating the electric brakes and including an actuator which is actuatable by the vehicle driver between at least first and second actuation phases which are separated by indication means that define a point of differentiation between said first and second actuation phases, said system operating the electric

brakes in a first mode of brake operation when said actuator is actuated in said first actuation phase and operating said electric brakes in a second mode of brake operation when said actuator is actuated to said second actuation phase, said second mode of operation applying said brakes in a different manner to said first mode of operation.

The indication means preferably takes the form of a resistance phase, which resists travel of the actuator from the first actuation phase to the second actuation phase, so that the second actuation phase is actuated only upon the resistance between the respective phases being overcome. Hereinafter, the indication means between the first and second phases will be a section of resistance. However, it is to be appreciated that alternatives could equally be employed, such as an audio, tactile or visual indication means.

A system according to the invention advantageously permits separation of different braking functions, so that for example, the type of braking that is conducted on a regular basis can be separated from other braking which is conducted on an irregular basis. In the operation of an electric parking brake, the separation might be made between static and dynamic application of the parking brakes. Static application is that which occurs when the vehicle is stationary (or substantially stationary, such as slow rolling) and the brakes are applied to maintain the vehicle stationary in the absence of service brake application. This is a regular form of brake application which occurs when the vehicle is parked and also when the vehicle is being driven, but is temporarily stationary.

Dynamic application occurs when the parking brakes are applied during travel of the vehicle and this type of application is typically an emergency application only, such as when the service brakes have failed or partially failed. Many drivers will never have the need to apply the brakes dynamically and it is therefore an irregular or very infrequent type of brake application. Accordingly, the system of the invention in one embodiment is operable in a first phase to apply the parking brakes for dynamic application and in a second phase for static application.

In the above arrangement, the resistance between the respective phases can be such as to provide clear differentiation between static and dynamic application of the parking brakes. That clear differentiation will be apparent to the vehicle driver, so that when a static application is required (as generally will be the case), the resistance which is met between the first and second phases will indicate to the driver that an appropriate static actuation has been made. In this arrangement, the load applied for static application is the maximum load available, whereas the dynamic load is variable, and unless automatically controlled, it is controlled by the vehicle driver. Thus, the driver can apply any suitable load for dynamic application up to the load level for a static application. This is one of many possible sequences. This sequence enables the driver to apply the parking brakes statically, on a regular basis, by actuating the actuator to the clearly defined point of resistance and into the second actuating phase. The actuator can be arranged to require low effort for each application with actuation by the driver terminating when the point of resistance is reached. When a dynamic application is required the load can be applied in any suitable manner upon actuation of the actuator, such as proportional to the amount of actuation, so that the driver does not necessarily have to apply maximum static load in a dynamic load application, but instead can apply a reduced load as might be more appropriate. As will be described later, the arrangement might be such as to allow modulation of the dynamic load, or to allow its release when appropriate, such as to prevent wheel lock, even though the vehicle may not have been fully stopped.

The level of resistance can be arranged as necessary to prevent inadvertent progression to the second phase, while the arrangement for application of the resistance can also take any suitable form. For example two compression springs provided in series could be used, wherein the springs are "caged" or "captured", and are arranged axially in the direction of actuation, but at differing levels of preload.

The resistance may apply for any desirable length of time proportional to the level of force applied by the vehicle driver. The resistance may only apply

for a short period in the event that sufficient force to progress through the resistance is provided. Alternatively, the resistance may be such as to require the force to be maintained by the driver for a longer period at the required force level.

In one arrangement, when the actuator has progressed through the resistance, the force required for the actuator to progress into or through the second actuation phase is greater than that required to progress through the resistance. In another arrangement, the system can be arranged so that the force required to progress through the second actuation phase progressively increases from the level required to progress through the resistance. Alternatively, the force required to progress through the second actuation phase may be a reducing force.

In one possible arrangement, once the vehicle driver has progressed the actuator through the resistance, static application of the brakes will occur. In a preferred arrangement, the level of braking force applied, whether statically or dynamically, is related to the degree of progression into the actuation phase. The relationship may be linear, or otherwise as required, such as parabolic. Accordingly, the vehicle driver has some control over the amount of braking force which is applied, by the extent to which the actuator is progressed.

In an alternative arrangement, the first, second or subsequent stages will each apply a set level of brake application which does not vary, although the system may be variable for setting purposes, i.e., when the system is installed, a number of braking loads for static and dynamic braking are set and can be re-set as necessary, but during operation, the system applies only one of a number of set loads depending on which of the actuation phases is activated. In this arrangement, the driver has no influence on the level of braking load applied apart from the set loads.

The actuator of the system of the invention can take any suitable form which is readily actuable by a vehicle driver. Such suitable forms include

switches, buttons, knobs, sliders, levers etc., all of which can be arranged according to the requirements of the invention.

In a preferred form, the actuator is an axially movable boss or button (hereinafter a "boss"), which can be depressed axially for actuation, or axially extended, or a combination of both. In an arrangement in which the boss is axially depressible, the boss can have an axial stroke comprising first and second sections, separated by a point, region or section of resistance. Preferably, depression of the boss through the first section is against only minor rearward pressure, such as against a light coil spring. The requirement for some rearward pressure is to ensure that the boss returns when required, to the pre-depressed condition. The rearward pressure may be provided by any other suitable arrangement, such as other forms of biasing or pressure exerting means. The preference for only a light rearward pressure, is to further ensure that dynamic application of the parking brakes, by actuation of the boss through the first section, is achieved with minimal effort by the vehicle driver. However, the resistance between the first and second sections is to ensure that the boss is not depressed to the second section inadvertently. Rather, the driver must deliberately depress the boss through the resistance before the boss can progress to the second stage of its axial travel for the system to initiate static parking brake application.

It will be appreciated that the boss form of actuator discussed above can be substituted by other actuator forms as outlined above. For those alternative forms, the resistance provided between the first and second actuation phases may be provided in a different manner to the spring biasing arrangement discussed above. For example, if the actuator is rotatable or pivotable, the resistance may be provided by a cam arrangement, or a detent arrangement.

It is to be appreciated that the various possible actuator forms and the various possible actuator resistance arrangements described above, are provided to create differing feels for the actuator operator (i.e. vehicle driver) to assist in selecting and confirming the appropriate actuator phase or mode.

Selection of an appropriate actuator phase or mode, in functional terms, triggers the desired operation of the brake.

Preferably the vehicle driver receives a visual indication regarding the setting of an actuator at any particular time. In one arrangement, the actuator may be retained in the position of actuation, so that the position is clearly evident at all times to the vehicle driver. For example, if the actuator is a depressible boss, the boss may retain a depressed condition after it has been depressed and prior to its release from the depressed condition, thus indicating to the vehicle driver the actuated position of the actuator. Alternatively, the actuator may not retain the actuated position and may for example return to the pre-actuated condition following actuation. In this arrangement a different form of visual indication may be provided, such as a signal appearing on the vehicle dashboard, or the actuator being illuminated. Other visual indicators may also be appropriate.

The electric nature of an electric parking brake system facilitates control of the system in a manner not normally available in manually operated systems. Accordingly, in a further aspect of the invention, the system may be arranged to operate in a substantially automatic mode, which requires little or no effort from the vehicle driver. In a preferred embodiment, the system is set to the automatic mode, either as a default each time the vehicle is driven, or as a required step initiated by the driver when automatic operation is required. In this automatic mode, the parking brakes are applied each time the system identifies that parking brake application is required. This can occur each time the vehicle becomes stationary, while release of the parking brake can be arranged when the driver initiates return of the vehicle to forward or rearward motion. This arrangement advantageously can eliminate the need for manual release of the parking brake on hill starts, which often is a difficult manoeuvre, particularly on steep hills.

The automatic mode can include both automatic application and release modes, or application only, so that release is left as a manual operation, or is a separate selectable automatic operation. The system can therefore be

arranged to distinguish between stationary and moving modes of the vehicle, and applies and releases the brakes respectively.

In the automatic mode of operation the system can be speed sensitive so that the parking brakes would not be applied unless the speed dropped below a certain value. The sensitivity of the equipment employed would influence how close to stationary the vehicle could be before a static brake application was deemed to be appropriate and a speed of say 3 kmh or below may be appropriate. The system could be arranged to provide a signal to the driver, say a visual signal such as a flashing light, to alert the driver that the vehicle speed is approaching the speed at which the parking brakes may automatically apply. The alert may prompt the driver to disable the automatic mode of operation, if the driving conditions do not warrant the application of the parking brakes, for example if the vehicle is in very heavy, slow moving traffic, whereby the parking brakes would be actuated very frequently. However, the driver in such traffic may elect to disable the system at his or her discretion and may not choose to do so for example, if the traffic is progressing up a hill.

Release of the parking brakes would rely on an input other than vehicle speed, given that, having applied the brakes on the basis of the vehicle speed dropping below a certain speed, the brakes will thereafter retain the vehicle against further movement until they are released. The control signal or input for brake release may therefore be generated or relate to accelerator depression, clutch engagement or gear selection. Signals or inputs generated by other relevant vehicle functions may also be employed.

In the automatic mode of the system, the system will monitor the vehicle speed for brake application and other suitable signals or inputs for brake release, but when the vehicle is parked and is to remain stationary for some time, the system preferably is arranged to recognise this and to place the system into an inactive mode. The inactive mode can be selected by the driver or the system when the vehicle ignition is turned off. The system then will no longer await a brake release signal or input. Upon re-ignition, the system can be arranged to maintain the parking brakes applied until a release signal or

input is received, whereby the system will thereafter operate in automatic mode if selected by the driver or if the system defaults to that mode unless a disabling function is activated.

The automatic mode may, in an alternative arrangement be sensitive simultaneously to vehicle speed and gear selection, so as to limit the automatic application of the parking brakes. For example, automatic application may be dependent on the system identifying a vehicle speed of less than 3 kmh and a gear selection of Park or Neutral. Other simultaneous parameters may be suitable system identifiers.

As discussed above, the parking brakes release capacity of the system can be separate from the automatic mode and may for example, still function when the automatic mode is disabled. For example, the system may be operated manually, whereby the vehicle driver activates the system actuator as required in the first and second actuation phases. Thus, the driver may activate the system to apply the parking brakes, while the system may be operable to release the brakes upon identification of a release signal or input. Therefore, the system can be arranged to eliminate the necessity for the driver to release the brakes even though the driver has the responsibility in this example for brake application. For this arrangement, two actuators may be provided, the first for manual application of the brakes as hereinbefore described, and the other to select automatic release.

The system may include parameters for dynamic application and for example, the parameters may be related to vehicle speed, so that a dynamic application made with the vehicle travelling at less than 3 kmh, is ignored. It is considered that a vehicle travelling at this speed can be adequately stopped by a static brake application. However, dynamic application is available with the vehicle travelling at a speed greater than 3 kmh and the system may be arranged to automatically modulate the braking force applied to the wheels, through an anti-lock braking system (ABS) if provided, to minimise wheel lock.

If ABS or a like system is not provided, then the system of the invention can provide for manual modulation by the vehicle driver. That is, by providing for variation in the dynamic braking force depending on how far the actuator is progressed, the driver can vary the braking force by manually varying the actuator progression. Accordingly, if the driver experiences wheel lock-up because the dynamic application of the brakes has been too high, the actuator can be retracted or released by the driver to lower the application load and so to permit the wheels to rotate to more efficiently retard the vehicle.

The system can be arranged, so that upon release of the actuator following a parking brake application, the system ignores further signals or inputs that may be received while the actuator progresses back through the resistance and first actuation phase. In one preferred embodiment the system is arranged to ignore signals when returning past earlier phases.

In a dynamic application in which the actuator remains within the first actuation phase and therefore does not progress to the second actuation phase, if the vehicle reaches a complete stop, the system will continue to monitor the load requirements for dynamic application, unless the vehicle driver elects to actuate the actuator to apply the parking brakes. If that occurs, then the system can ignore further signals or inputs when the actuator is released for release of the parking brakes as discussed above. Also, with the parking brakes applied following dynamic application, the system can be arranged to monitor set vehicle parameters, so as to be ready to release the brakes if the driver chooses to recommence driving of the vehicle.

The system can be arranged to include an initialisation position to initialise the brakes prior to first use, for example as part of the vehicle production process, or whenever the brakes are adjusted during maintenance. Initialisation "beds" the cable and brake system to remove any permanent stretch and set a correct cable slack. The initialisation load preferably is high to achieve optimum bedding of the brakes and the system can be arranged so that the maximum brake application forms the initialisation load. Thus, in a

preferred arrangement, actuation of the actuator in the maximum, provides a quick mechanism for initialising the brakes.

In an alternative arrangement, initialisation may be initiated by a second actuator, that could have the same or a different form from the first actuator. Actuation of the second actuator could operate the system as above described for initialisation, although, the second actuator may be positioned in the vehicle, at a convenient position for access by production and maintenance personnel only, and not the vehicle driver.

Progression of the actuator through the first and second actuation phases can be monitored by any suitable means suitable to cause the system to react appropriately in respect of brake application. One or more potentiometers, such as for sensing linear or angular actuator position, may be provided for this.

The actuator can have more than a single degree of movement and in the example of an axially depressible boss, the boss may also be rotatable, to provide separate operating functions. Alternatively, separate actuators for different functions may be provided. In one arrangement, a boss can be provided which is axially depressible to initiate a number of modes of brake application, and which is rotatable about its longitudinal axis to operate further modes of operation. Alternatively, it can be axially depressed after selecting a second rotary position to activate further modes of operation, i.e. the rotary motion could trigger additional brake functions or could be a selecting function to enable another axial motion that activates additional brake function. For example, the boss rotation could alter the mode from solely automatic operation, to manual brake application and automatic brake release, to complete disablement. Preferably the rotation between positions is indexed. Alternatively, as discussed above, such a boss could be extendible rather than depressible.

Where the invention provides for manual and automatic operation, the actuator may be respectively actuatable for each of the operations in what can be

termed positive and negative directions. In respect of an axially movable boss, positive movement may be depressing movement from a home position while negative movement may be reverse, extending movement from the home position. An axially movable and rotatable boss may alternatively be depressible or extendible in each of two separate rotated positions, to distinguish between manual and automatic operation and different phases of those respective operations. Still alternatively, separate actuators may be provided for manual and automatic operation, with the automatic operation overriding any subsequent attempt at manual operation when automatic operation has been selected.

The attached drawings show an example embodiment of the invention of the foregoing kind. The particularity of those drawings and the associated description does not supersede the generality of the preceding broad description of the invention.

In the drawings:

Fig. 1 is a front perspective view of a first preferred embodiment of a system actuator incorporating the present invention.

Fig. 2 is a front perspective view of a second preferred embodiment of a system actuator incorporating the present invention.

Fig. 3 is a front perspective view of a third preferred embodiment of a system actuator incorporating the present invention.

Fig. 4 is a front perspective view of a fourth preferred embodiment of a system actuator incorporating the present invention.

Fig. 5 is a front perspective view of a fifth preferred embodiment of a system actuator incorporating the present invention.

Fig. 6 is a diagrammatic perspective view of a sixth preferred embodiment of a system actuator incorporating the present invention.

Fig. 7 is a graph of force versus actuator displacement of one embodiment of a system incorporating the present invention.

Referring to Fig. 1, a system actuator 10 is provided, which includes dial 11. The dial 11 includes a mode setting indicator 12. The dial 11 is rotatable. A face plate 13 is provided, which includes a number of phase indicators to

enable a vehicle driver (not illustrated) to visually determine the current actuator phase, and to select another actuator phase. The phase indicators provided include a first (or automatic) phase indicator 14 and a second (or manual) indicator 16. The dial 11 can be rotated (or actuated) by the vehicle driver, as desired, to either the automatic phase indicator 14 or manual phase indicator 16 to initiate the automatic and manual phases (or modes), respectively.

If the vehicle driver selects the automatic mode, then the parking brake (not illustrated) is applied each time the system identifies that parking brake application is required, in response to a predefined control signal. The automatic mode can include both automatic brake application and release modes, or automatic brake application only, so that release is left as a manual operation, or is a separate selectable operation.

Alternatively the vehicle driver can select the manual mode. In this mode, as illustrated in Fig. 1, the driver can apply any desired level of brake force in the manual mode within a predefined range. The application of brake force of the system can be set at an off (or zero) setting 18 when in the manual mode. This setting may be desirable to deactivate the system when not required. Alternatively the level of brake force in the manual mode can be increased linearly (or non-linearly if desired) to any desired level up to a maximum pre-defined setting 20 (indicated in Fig. 1 as "100%").

The vehicle driver experiences a physical interference when rotating/actuating the dial 11 from the manual mode to the automatic mode and vice-versa; this physical interference being in the form of a noticeable notch or "click". This assists the driver in accurately selecting the required mode.

Also, the driver experiences a resistance which increases linearly (or otherwise) when in the manual mode and actuating the dial 11 from the zero setting 18 up to the predefined maximum setting 20 and vice-versa. The provision of varying resistance reduces the likelihood of the driver inadvertently increasing the manual setting above that intended.

The dial 11 is actuable axially between (at least) two positions. The dial is biased axially to the position illustrated in Fig. 1, and in this position is in a safety or deactivated position. In order to alter the system setting the driver must depress or pull the dial such that the dial moves to its second defined position (not illustrated). The driver is able to alter the system brake setting by rotating the dial 11 only while maintaining the dial 11 in the depressed or extended position.

The system actuator illustrated in Fig. 2 is provided in the form of a lever 22. The lever 22 is actuated both axially and rotatably. Axial actuation of the lever 22 could correspond to any two or more system settings. Likewise rotating of the lever 22 could correspond to any two or more system settings. Thus the axial and rotatable actuation of the lever 22 enables the associated system to be switched to any one of a number of possible vehicle brake settings, including (but not limited to) automatic, manual, dynamic, static, and child-proof safety settings. The lever 22 could be indexed for ease of use.

The pedal 24 illustrated in Fig. 3, like the lever 22 illustrated in Fig. 2, is rotatably and axially (or laterally) actuated. The pedal 24 could also enable an associated system to be switched to any one of a number of possible vehicle brake settings of the type referred to in relation to Fig. 2 (but not necessarily limited thereto).

Fig. 4 illustrates a system actuator, which includes a multi-position push button switch 24 and second two-position push button (or intention) switch 26. As one example, the intention switch 26 could be used to select either automatic or manual parking brake operation.

Fig. 5 illustrates a system actuator in the form of a dial 28, which can be switched to any one of three(or more, not shown) defined (indexed) positions 30, 32, 34. Thus, dial 28 can be used to adjust the system to any of three(or more) possible vehicle brake modes.

Fig. 6 illustrates schematically a system actuator in the form of a dial 36, which is axially movable between four defined (indexed) positions(and or three phases) and rotatably moveable between two defined positions. The dial 36 is thus movable by the vehicle driver between any one of eight possible positions, 38, 40, 42, 44, 46, 48, 50, 52.

As but one example, dial positions 38 and 40 could be system off/inactive/safety settings. Positions 42, 44 and 46 could be system automatic mode settings.

Position 42 could be an automatic static setting, such that the system automatically activates when the vehicle speed drops below some pre-defined limit (say 3 km/h), and deactivates on receiving a control signal indicating accelerator depression, clutch engagement or gear selection.

Position 44 could be a setting for automatic dynamic application of the brakes in response to the system receiving some pre-determined control signal.

Position 46 could be used for any other desired automatic setting.

Position 48 could be a manually operated park brake activator setting.

Position 50 could be a manually operated setting for either or both dynamic emergency braking or a manual hill start.

Finally, position 52 could be a manually operated setting to fully lock the brake for a static hill hold.

It is to be appreciated that there could be more or less positions in both the axial and rotary movements.

Also, it is to be appreciated that additional settings could be provided between any two or more of the positions 38, 40, 42, 44, 46, 48, 50, 52, thereby allowing, for example, a modulated setting.

Figure 7 illustrates graphically one possible relationship between the system button (or actuator) displacement and the force applied to the actuator by the driver. The graph illustrates how each phase is separated by discernible end points and some of the phases could have a progressive resistance associated with the travel. In the embodiment illustrated graphically, the first phase of the button actuation relates to any one (or possibly a combination) of the system "Set and Forget"/"Drive Away Assist"/"Hill Start" phases. A stepwise increase in driver force is required to then actuate the button to reach the second system phase, that being the "Dynamic Emergency Brake Apply" phase.

It is to be understood that various modifications, alterations and/or additions may be made to the system actuator previously described without departing from the spirit or ambit of this invention.

CLAIMS

1. A system for a vehicle which employs electric brakes, said system being operable for operating the electric brakes and including an actuator which is actuatable by the vehicle driver between at least first and second actuation phases which are separated by indication means that define a point of differentiation between said first and second actuation phases, said system being operable to operate the electric brakes in a first mode of brake operation when said actuator is actuated in said first actuation phase and to operate said electric brakes in a second mode of brake operation when said actuator is actuated to said second actuation phase, said second mode of operation applying said brakes in a different manner to said first mode of operation.

2. A system according to claim 1, said indication means comprising a section of resistance between said first and second actuation phases, said actuator progressing through said first actuation phase and said section of resistance prior to said second actuation phase.

3. A system according to claim 2, wherein said actuator encounters resistance to progression through said second actuation phase.

4. A system according to claim 3, said resistance to progression in said second actuation phase being greater than the level of resistance encountered by said actuator in said section of resistance between said first and second actuation phases.

5. A system according to claim 3, said resistance to progression in said second actuation phase increasing from an amount substantially equal to the level of resistance of said section of resistance between said first and second actuation phases just prior to said actuator progressing into said second actuation phase.

6. A system according to claim 3, wherein said resistance of said second actuation phase reduces as said actuator progresses through said second actuation phase.

7. A system according to any one of claims 1 to 6, said first mode of brake operation being dynamic parking brake application and said second mode of brake operation being static parking brake application.

8. A system according to any one of the preceding claims, wherein the level of braking force applied by said electric brakes in at least one of said first and second actuation phases is directly related to the extent of progression of said actuator through at least one of said first and second actuation phases.

9. A system according to claim 8, wherein the level of braking force applied by said electric brakes in at least one of said first and second actuation phases, increases relative to the extent of progression of said actuator through said at least one of said first and second actuation phases.

10. A system according to any one of claims 1 to 7, wherein the level of braking force applied by said electric brakes in at least one of said first and second actuation phases, is constant regardless of the extent of progression of said actuator through said at least one of said first and second actuation phases.

11. A system according to any one of the preceding claims, said actuator having linear or rotatable actuation movement through said first and second actuation phases.

12. A system according to any one of claims 1 to 10, said actuator having linear and rotatable actuation movement through said first and second actuation phases.

13. A system according to claim 11 or 12, said actuator being actuatable through further actuation phases by linear or rotatable actuation.

14. A system according to any one of the preceding claims, said actuator being in the form of any one of a switch, a button, a boss, a dial, a knob, a slider, a pedal or a lever.

15. A system according to claim 14, said actuator being an axially movable boss, wherein axial movement of said boss takes place through said first actuation phase, then through said indication means and then through said second actuation phase.

16. A system according to claim 15, said boss being moved through said first actuation phase against minor pressure sufficient to return said boss from within said first actuation phase to a pre-actuation position prior to movement when the load which causes said boss to move is removed.

17. A system according to claim 16, said indication means comprising a section of resistance between said first and second actuation phases and said resistance of said section of resistance being substantial compared to said minor pressure of said first actuation phase.

18. A system according to any one of claims 15 to 17, said axial movement of said boss including axial depression.

19. A system according to any one of claims 15 to 17 said axial movement of said boss including axial extension.

20. A system according to claim 14, said actuator being a rotatable dial, wherein rotation of said dial takes place through said first actuation phase, then through said indication means, and then through said second actuation phase.

21. A system according to any one of claims 1 to 20, wherein said actuation phases initiate modes of brake operation including one or more of manual brake operation, automatic brake operation, static parking brake operation or dynamic parking brake operation.

22. An electric parking brake system for a vehicle, said system including automatic operation of the electric parking brakes of said vehicle in at least a first mode of brake operation.

23. A system according to claim 22, wherein said system is operational in a first automatic mode of brake operation and a second manual mode of brake operation and said system allows manual switching between said first and second modes of brake operation.

24. A system according to claim 22 or 23, wherein said automatic operation includes automatic application of said electric parking brakes upon identification of a parameter which facilitates parking brake application.

25. A system according to claim 24, said parameter including vehicle speed, wherein upon identification of said vehicle becoming stationary, said system facilitates application of said electric parking brakes.

26. A system according to claim 24, said parameter including vehicle speed, wherein upon identification of a vehicle speed of a predetermined value, said system facilitates application of said electric parking brakes.

27. A system according to claim 26, said predetermined value of said vehicle speed being about 3 km/hr.

28. A system according to any one of claims 24 to 26, said electric parking brakes being manually releasable by the vehicle driver.

29. A system according to any one of claims 24 to 28, said electric parking brakes being automatically releasable by said system upon identification of parameters which facilitate parking brake release.

30. A system according to claim 29, said parameter including accelerator depression.

31. A system according to claim 29, said parameter including clutch engagement.

32. A system according to claim 29, wherein said system includes active and inactive modes, said system being operable in said active mode when said vehicle is in a general driving mode and being operable in said inactive mode when said vehicle ignition has been turned off so that said vehicle is stationary and not in said driving mode, wherein in said inactive mode said system ceases monitoring vehicle parameters.

33. A system according to claim 32, said system automatically returning from said inactive mode to said active mode upon re-ignition of said vehicle.

34. A system according to claim 33, said system being operable to maintain said electric parking brakes applied upon said system returning from said inactive mode to said active mode, until said electric parking brakes are released manually, or automatically by said system.

35. A system according to claim 22, said system including a manual brake application mode and an automatic brake release mode, wherein said electric parking brakes can be applied manually as required and said system is operable to automatically release said electric parking brakes upon identification of suitable brake release parameters.

36. A system according to claim 35, said brake release parameters including accelerator depression or clutch engagement.

37. A system according to any one of claims 22 to 36, said system being operable to initiate both a static and a dynamic application of said electric parking brakes.

38. A system according to claim 37, wherein said system is operable to initiate dynamic application only when the speed of said vehicle exceeds a predetermined speed.

39. A system according to claim 38, said predetermined speed being above 3 km/hr.

40. A system according to claim 38 or 39, said system being operable to modulate the dynamic braking force applied to the vehicle wheels to minimise wheel lock.

41. A system according to claim 40, wherein modulation is achieved through an anti-lock braking system.

42. A system according to claim 40, including an axially depressible boss in which the level of dynamic load applied is directly related to the extent to which the boss is depressed, and wherein modulation is achieved manually by varying the extent of axial depression of said boss.

43. A system according to claim 37, wherein said dynamic brake application can be released prior to said vehicle reaching a complete stop and said system is arranged to ignore signals to initiate brake application as said actuator returns to a pre-actuation position.

44. A system according to claim 37, further including facility to initialise the electric parking brakes prior to first use, by application of a load greater than the dynamic load.

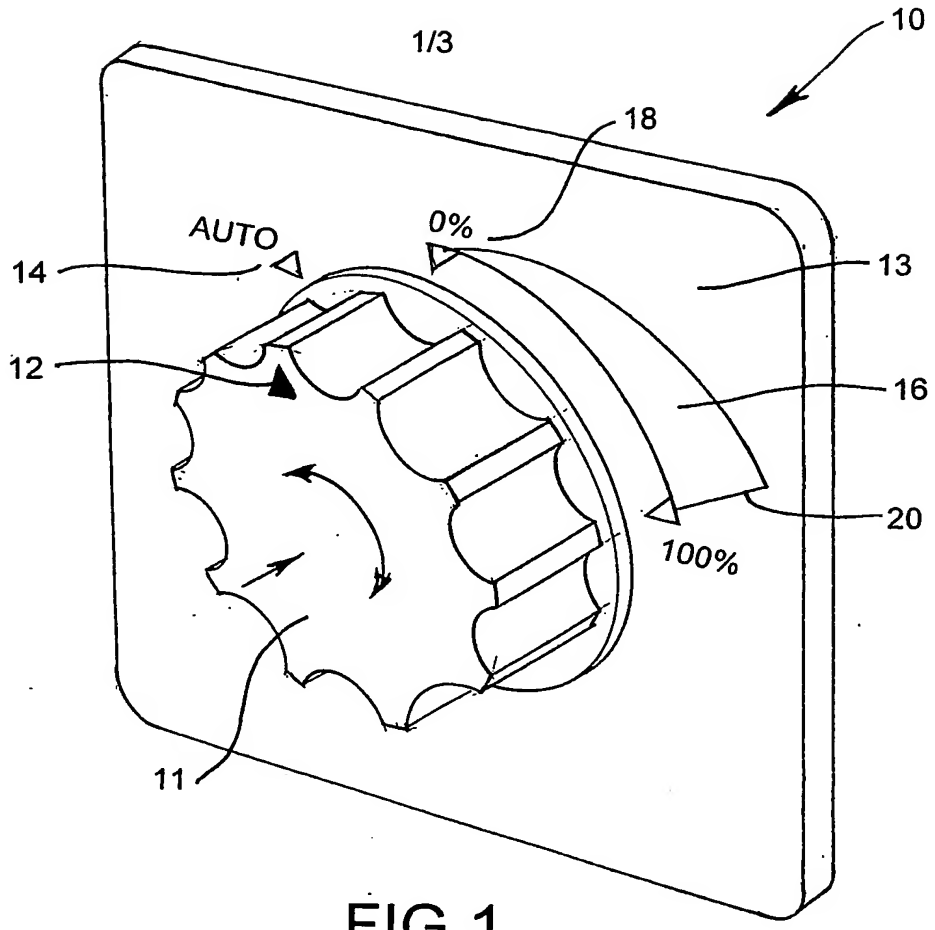

FIG 1

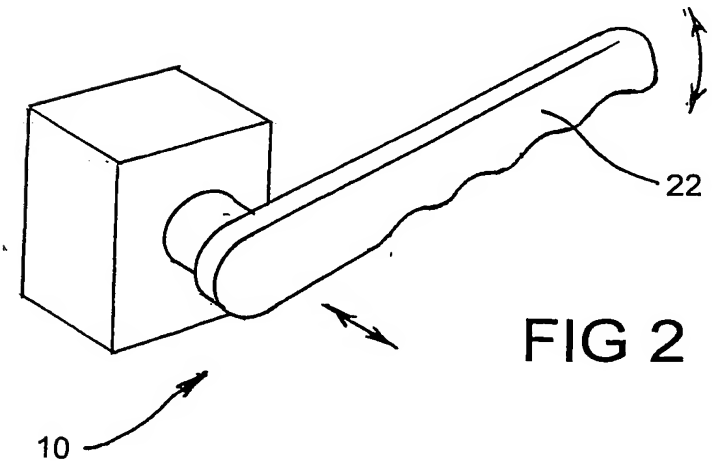

FIG 2

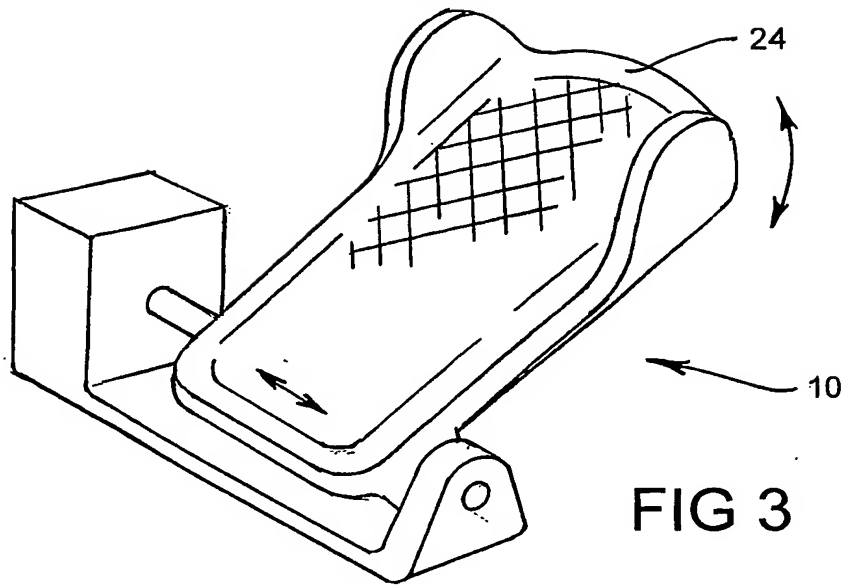

FIG 3

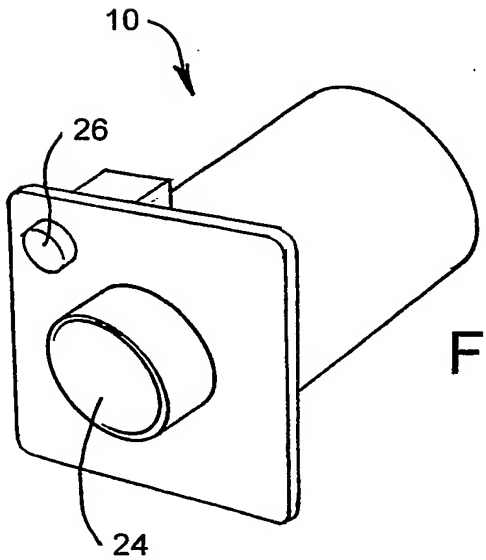

FIG 4

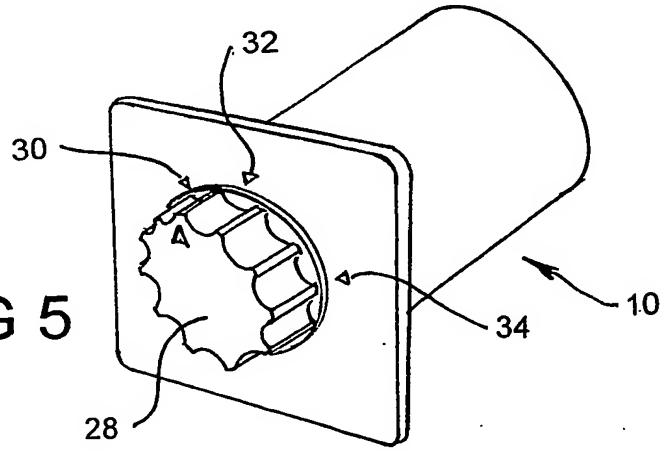

FIG 5

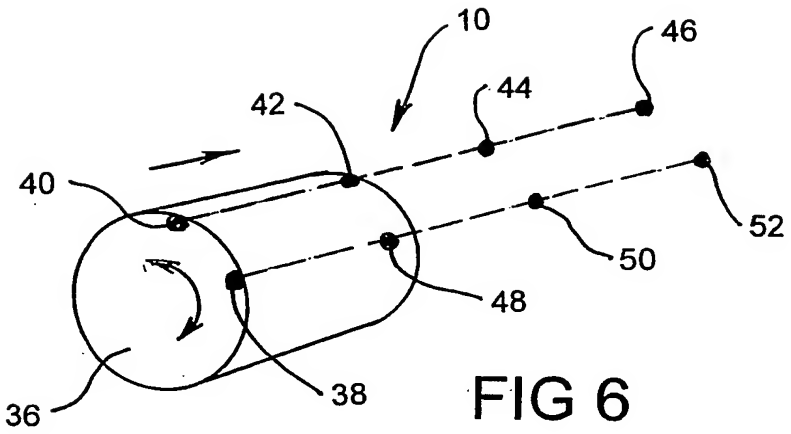
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FIG 6

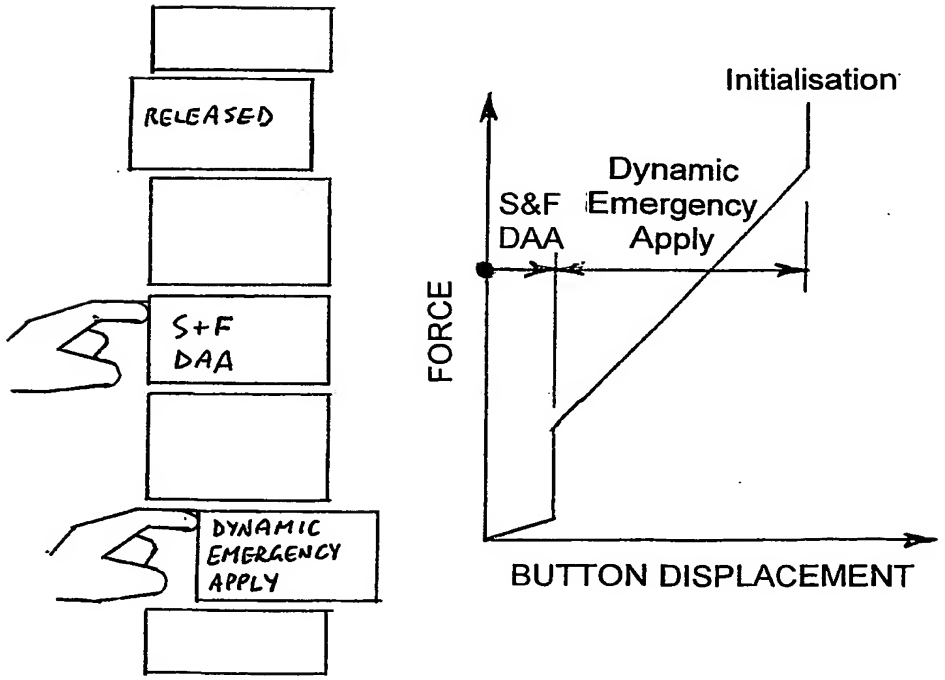
RELEASED
S+F
DAA
DYNAMIC
EMERGENCY
APPLY
Initialisation
Dynamic
Emergency
Apply
S&F
DAA
FORCE
BUTTON DISPLACEMENT

FIG 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00798

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B60T 7/02, 7/12, 13/00, 13/74, F16D 59/00, 65/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI: IPC B60T 7/(all), 13/(all), F16D 59/(all), 65/(all) with keywords (electric, phase, indicate, different, parking, automatic)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	EP 978432 A1 (AUTOMOBILES PEUGEOT et al) 9 February 2000	
X	Whole document	1-21
Y		3, 8, 14, 20-21
	FR 2793203 A1 (RENAULT) 10 November 2000	
X	Whole document	1-21
Y		3, 8, 14, 20-21
	US 4901953 A (MUNETIKA) 20 February 1990	
Y	Whole document	3

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 July 2003	03 NOV 2003
Name and mailing address of the ISA/AU	**Authorized officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	**ZBIGNIEW BIELAWSKI** Telephone No : (02) 6283 2218

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00798

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 00/20266 A1 (VOLVO PERSONVAGNAR AB) 13 April 2000 Whole document	22-44 8, 14, 20-21
X	US 6406102 B1 (ARNOLD) 18 June 2002 Whole document	22-44
X	US 6386338 B1 (POWROZEK) 14 May 2002 Whole document	22-44
X	US 2001/0030093 A1 (LUNDHOLM et al) 18 October 2001 Whole document	22-44
X	US 5139315 A(WALENTY et al) 18 August 1992 Whole document	22-44
X	GB 2342967 A (ROVER GROUP LIMITED) 26 April 2000 Whole document	22-44
X	WO 91/04167 A1 (ORSCHELN CO.) 4 April 1991 Whole document	22-44
X	WO 90/15743 A1 (VOLKSWAGEN AG) 27 December 1990 Whole document	22-44
X	EP 741066 B1 (BAYERISCHE MOTOREN WERKE AG) 27 September 2000 Whole document	22-44
X	DE 10061006 A1 (CONTI TEMIC MICROELECTRONIC GmbH) 13 June 2002 Whole document	22-44
X	DE 19901581 A1 (MICRO COMPACT CAR SMART GmbH) 11 May 2000 Whole document	22-44
X	DE 4434596 A1 (MERCEDES-BENZ AG) 12 October 1995 Whole document	22-44

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00798

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 4421088 A1 (J.M. VOITH GmbH) 27 October 1994 Whole document	22-44
X	DE 4315877 A1 (MERCEDES-BENZ AG) 15 September 1994 Whole document	22-44

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00798

Box I Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos :

because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos :

because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos :

because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See the extra sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00798

Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: II

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are different inventions as follows:

1. Claims 1-21 are directed to a system including an actuator for operating an electric brakes of a vehicle in two different modes of operation wherein the actuator first and second actuation phases corresponding to said modes of operation are separated by indication means to differentiate between the two actuation phases. It is considered that said operating system comprises a first "special technical feature".

2. Claims 22-44 are directed to an electric parking brake system including automatic operation of the brake in at least a first mode of operation. It is considered that the underlined feature comprises a second "special technical feature".

Since the abovementioned groups of claims do not share any of the technical features identified, a "technical relationship" between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept, a priori.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU03/00798

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	978432	FR	2782178				
FR	2763203	NONE					
US	4901953	JP	63257329				
WO	200020266	AU	200010888	EP	1117579	SE	9803336
		US	2001032760				
US	6406102	NONE					
US	6386338	EP	1211150	JP	2002178892	US	2002066623
US	2001003009	AU	61365/98	WO	9836261	US	2003031781
US	5139315	NONE					
GB	2342967	NONE					
WO	9104167	AU	55308/90	US	5004077		
WO	9015743	EP	479841				
EP	741066	DE	19516639				
DE	10061006	WO	200246017				
DE	10025731	NONE					
DE	19901581	NONE					
DE	4434596	NONE					
DE	4421088	EP	687604				
DE	4315877	NONE					

END OF ANNEX